Before the
NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION
Washington, DC 20230

In the Matter of	)	
	)	
Development of a National Spectrum Strategy	)	230308–0068
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COMMENTS OF EESS OPERATORS

ATLAS Space Operations, Inc., Fleet Space Technologies, HawkEye 360, ICEYE US, Inc., Lunasonde, Inc., Maxar Technologies Inc., Planet Labs PBC, Spire Global, Inc., and Tomorrow.io (together, the "EESS Operators") submit the following comments on the National Telecommunications and Information Administration's ("NTIA") Request for Comment on the development of a national spectrum strategy ("RFC").[1] The EESS Operators appreciate this opportunity to discuss the importance of spectrum to the success of the vibrant and innovative U.S. commercial remote sensing industry. Below, the EESS Operators provide feedback and suggestions on how the National Spectrum Strategy can account for the spectrum needs of EESS Operators to continue to support the industry's growth, development, and innovation. In particular, the EESS Operators ask that the National Spectrum Strategy recognize the value of innovative commercial remote sensing technologies and the importance of preserving the Earth Exploration Satellite Service ("EESS") spectrum they rely upon. The Strategy should also describe the need for space-to-space spectrum allocations for EESS and other new space constellations.

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[1] Nat'l Telecomm. & Info. Admin., *Development of a National Spectrum Strategy*, 88 Fed. Reg. 16244 (Mar. 16, 2023).

I. Commercial Satellite Remote Sensing Is a Growing Space Industry and Relies on Access to Adequate Spectrum Resources

Commercial satellite remote sensing is a growing and innovative space industry that contributes significantly to U.S. space leadership. Remote sensing broadly encompasses any methods for imaging or gleaning data about what is happening on Earth from space. Once primarily the province of governments, the commercial remote sensing industry now comprises a variety of operators with different capabilities, from providing electro optical imaging of the Earth, to sensing radiofrequency emissions on the Earth, to providing other types of data. This data can be incorporated into and support a host of diverse critical applications, including national security, disaster response, climate change research and quantification, and agriculture.

The commercial remote sensing industry experienced an eightfold increase in the number of satellites between 2012 and 2021.[2] The industry continues to grow at a compound annual growth rate of 11.5 percent, and is projected to reach USD $16.35 billion in value by 2030.[3] North America is the largest market for remote sensing technologies globally, driven in large part by the innovation of remote sensing companies based in the United States.[4] These U.S. companies, many of which are signatories to these comments, are world leaders in the development and deployment of remote sensing satellite and ground station technologies, products, and services.

To facilitate this continued growth, innovation, and leadership, commercial remote

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2 Bryce Tech, Satellite Industry Association: State of the Satellite Industry Report 2022, at 25-26 (2022).

3 Globe Newswire, *Remote Sensing Technology Market Projected to Garner USD 16.35 Billion by 2030, Growing at 11.5% CAGR - Report by Market Research Future (MRFR)*, Press Release, Market Research Future (July 4, 2022), https://www.globenewswire.com/en/news-release/2022/07/04/2473394/0/en/Remote-Sensing-Technology-Market-Projected-to-Garner-USD-16-35-Billion-by-2030-Growing-at-11-5-CAGR-Report-by-Market-Research-Future-MRFR.html.

4 *See id.*

sensing operators need sustained access to the critical spectrum allocations that enable EESS operations in the United States, all of which are currently shared and coordinated with Federal users. The aforementioned growth also emphasizes the need for the identification of additional spectrum, including for space-to-space transmissions within and between satellite networks.

II. The National Spectrum Strategy Should Emphasize the Importance of Maintaining Critical Satellite Spectrum Resources, Including the X-Band and Ka-Band Frequencies, to Support Space Industry Innovation

A. The X-Band and Ka-Band Are Critical to Support Satellite Remote Sensing in Support of National Security, Civil, and Commercial Applications

The national spectrum strategy should take note of the importance of Federal and non-Federal EESS spectrum allocations, including the 8025-8400 MHz "X-band" and 25.5-27 GHz EESS "Ka-band," in supporting a variety of industry and government use cases, in particular U.S. military and intelligence operations. Commercial remote sensing operators provide imagery, analytics, and other data that enable enhanced global awareness and transparency, including most recently in Ukraine. Accordingly, maintaining U.S. leadership in commercial remote sensing is critical for national defense.

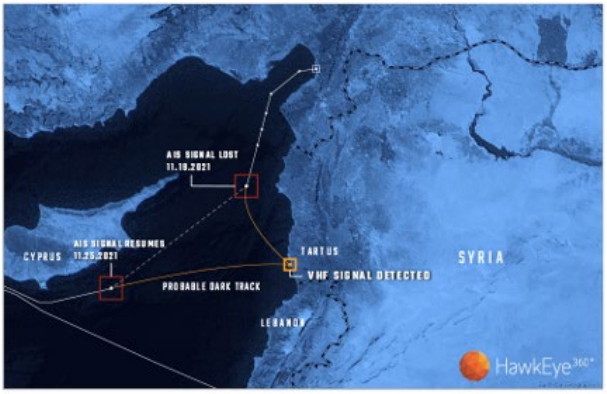
Commercial remote sensing operators also offer other important, innovative scientific, civil, and commercial applications, such as:

- Providing U.S. civil government agencies with scientific data for vital research;
- Enabling climate monitoring and environmental responsibility reporting;
- Enabling governments and industry to pinpoint the location of underwater oil and gas leaks;
- Allowing farmers, scientists, and governments to obtain detailed agricultural data to gain insights on global issues such as food security; and
- Keeping companies abreast of issues affecting their business, from monitoring

shipping lanes, tracking cargo, and other supply chain activity to retail signals and risk assessment.

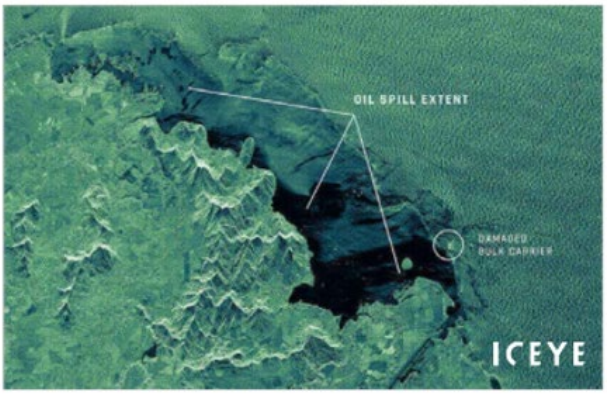
A few examples of these applications appear below.

DEFORESTATION • Pará, Brazil • Optical • Planet Labs PBC



DARK SHIP DETECTION · Port of Tartus · RF Geolocation · HawkEye 360

ENGELS AIR BASE • Russia • Optical • Maxar Technologies



OIL SPILL • Mauritius • Synthetic Aperture Radar (SAR) • ICEYE

The National Spectrum Strategy should recognize the importance of this growing commercial sector and outline measures necessary to preserve adequate EESS spectrum resources, including the EESS X-band allocation, as well as the EESS Ka-band downlink as an expansion band for commercial remote sensing providers. The X-band is widely used by both government and commercial EESS operators and provides a combination of ideal propagation characteristics for remote sensing and minimal interference risks between remote sensing operators. Although not a substitute for X-band downlink given different propagation

characteristics, the Ka-band is also in regular use by EESS operators. The wide bandwidth available at 25.5-27 GHz helps facilitate the downlink of the large amounts of data generated by remote sensing systems. Accordingly, NTIA's spectrum strategy should also recognize the importance of this EESS downlink band for commercial remote sensing innovation and future expansion.

B. Terrestrial Mobile Use of X-Band Would Undermine Important EESS Services

The vital remote sensing use cases described above would be threatened if the wireless radio frequency spectrum relied upon by remote sensing satellites were allocated for terrestrial mobile use. Policymakers should preserve X-band spectrum for critically important and rapidly growing satellite operations. The terrestrial mobile community has asked policymakers to support reallocating and auctioning 400 MHz of spectrum in the 7125-8400 MHz range for terrestrial mobile use.[5] However, the top 375 MHz of this range – the portion of the X-band used for satellite remote sensing – must be preserved for commercial remote sensing. The X-band serves as anchor spectrum for a significant portion of commercial EESS downlink operations in the United States. As such, the band is already robustly used and shared among government and commercial missions. Introducing new terrestrial mobile applications would

[5] *See, e.g,* Meredith Attwell Baker, *More Licensed Spectrum Is Needed to Drive U.S. Innovation*, CTIA (Dec. 7, 2022), https://www.ctia.org/news/more-licensed-spectrum-is-needed-to-drive-u-s-innovation ("[T]hree blocks of lower mid-band spectrum (3.1-3.45, 4.4-4.94, 7.125-8.4 GHz) . . . if allocated to exclusive, licensed commercial use, at full power, could help us meet surging demand and achieve 5G's full potential. . . ."); CTIA, *Spectrum Allocation in the United States* (Sept. 28, 2022), https://www.ctia.org/news/spectrum-allocation-in-the-united-states (calling for 400 MHz in the 7 to 8.4 GHz range).

significantly reduce the utility of the band for current satellite operations and potentially limit industry growth and innovation.

Terrestrial use of the X-band could cause significant disruptions to EESS operations because ground stations are highly sensitive to signals transmitted by other nearby operations. EESS downlinks typically operate at much lower power spectral density than terrestrial mobile links and rely on much larger gateway antennas compared to terrestrial mobile communications antennas. To maximize coverage to the EESS satellites, these antennas often must operate at very low elevation angles. This combination of low elevation angles and sensitive receivers makes them extremely susceptible to interference from terrestrial mobile systems operating at high duty cycles, even at levels that would not cause interference into other terrestrial systems. The transient and varying nature of the links (because of the antenna tracking on the ground and the satellite motion) mean that interference might not be immediately evident and would be hard to diagnose and resolve.

Preserving the X-band for satellite use would support the commercial remote sensing industry, improve U.S. national security, and encourage the development of new scientific applications that could help the world track and respond to climate change. The National Spectrum Strategy should encourage continued robust access to EESS allocations such as the X-band and should not consider X-band spectrum among the megahertz it proposes to make available for mobile use.

III. The National Spectrum Strategy Should Recognize the Need for Additional Satellite Spectrum Allocations to Support Innovative Services Such as Intersatellite Links

EESS satellite operators rely heavily on a limited amount of radio frequency spectrum to send and receive important information to and from their satellites. Everything from commands

to the satellite and telemetry about the health of the satellite, to "payload downlink" for terabytes of images and other data that the satellite collects transits only a few gigahertz of radio frequency spectrum. Moreover, time is often of the essence to deliver satellite data to the companies and governments that rely on it, including for use cases such as disaster response, security, wildfire prevention, and other applications. However, EESS satellites typically only downlink data to ground stations when passing directly over a ground station site and, as a result, commands to and transmissions from the satellite must wait until the satellite is in view of a ground station site.

Intersatellite links ("ISLs") present an important opportunity for the remote sensing industry. By enabling operators to relay commands between satellites in space—both within their own constellations and among other partner networks—operators can decrease the delay between the time a satellite is tasked to the time an image is delivered to a customer. Moreover, ISLs provide a persistently available connection with satellites that increases safety of space operations. There are efforts underway at the International Telecommunication Union ("ITU") to identify and allocate new frequencies for ISL use, which will improve reactivity and space safety and reduce latency. The EESS Operators understand that such ISL use is consistent with NTIA's proposal for WRC-23 Agenda Item 1.17 and the extensive studies performed in the ITU Radiocommunication sector, demonstrating that appropriately conditioned satellite-to-satellite links would not raise interference issues to other incumbent services.[6] Accordingly, the U.S. should support the use of ISL for these new technologies and capabilities and the National Spectrum Strategy should call for appropriate ISL allocations.

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[6] *See* Letter from Steve Molina, NTIA, to Tom Sullivan, FCC (Jan. 9, 2023), *available at* https://www.fcc.gov/ecfs/document/104062381209830/40; *Conference Preparatory Meeting for WRC-23*, Plenary Meeting, Working Group 4: Chapter 4, Agenda Item 1.17, CPM23-2/271-E, ITU (Apr. 5, 2023), *available at* https://www.itu.int/md/R19-CPM23.2-C-0271/en.

IV. Conclusion

The EESS Operators appreciate NTIA's efforts toward development of the next National Spectrum Strategy at a time when spectrum is both more crowded and more needed than ever before. The EESS Operators stand ready to partner with NTIA as it develops and implements the Strategy.

Respectfully Submitted,

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Appendix: Company Information

ATLAS Space Operations, Inc.

ATLAS Space Operations, Inc. is a U.S. owned, non-traditional small business. As one of the first companies to pioneer cloud services for SATCOM, ATLAS provides satellite RF communication services to the Government and commercial sectors. ATLAS' approach is to abstract the service to the Client with software and virtualize the underlying components. Through geographical dispersion of its ground stations and cloud services, ATLAS provides a resilient capability that delivers dependable low latency data. ATLAS owns and operates 13 ground stations globally and its recent integration with two key players, (AWS and Viasat-RTE) in the industry expanded its network to over 40 ground stations. ATLAS has commercialized the technology to connect disparate ground systems, thus improving efficiency and providing the security the Government requires, while also reducing the need for additional manpower. Freedom Ground Software as a Service™ is designed to maximize machine-to-machine interfaces making full use of modern computing capabilities for service automation to simplify operations, so satellite operators need not also be ground station operators. All features can be extended to other systems whether it is a single antenna, a network, or a complex mesh network of disparate systems. As the operator of federated network, ATLAS excels at integrating any ground system, regardless of site owner or hardware.

Fleet Space Technologies

Fleet Space is an agile space company based in South Australia. Our mission is to Connect Everything using cutting-edge communications and space technologies to enable the next giant leap in human civilization. Fleet Space made history by launching Australia's first four commercial nanosatellites in November 2018. Over the course of three weeks, Proxima 1 & 2 and Centauri 1 & 2 were launched into Low Earth Orbit. Fleet is continuing its work on the Centauri Program, having launched its fifth and sixth satellites in 2021, and the next batch of satellites in 2022. We are experts in remote connectivity systems. Australia's particular connectivity challenges have been a major driver in creating new connectivity technologies. We specialize in creating low-cost satellite based systems for Industrial Internet of Things applications. We're using space technologies to simplify IoT because improving efficiency in industry shouldn't be rocket science!

HawkEye 360

HawkEye 360 is a Radio Frequency (RF) data analytics company. We operate a first-of-its-kind commercial satellite constellation to identify, process, and geolocate a broad set of RF signals. We extract value from this unique data through proprietary algorithms, fusing it with other sources to create powerful analytical products that solve hard challenges for our global customers. Our products include maritime domain awareness and spectrum mapping and monitoring; our customers include a wide range of commercial, government and international entities. The HawkEye 360 constellation is currently comprised of 21 satellites on orbit,

operating in 7 "clusters" of 3 satellites each. HawkEye 360 has received authorization from the FCC to operate up to 60 satellites simultaneously as its constellation with a lifetime authorization of 174 satellites.

ICEYE US, Inc.

ICEYE US, Inc., based in Irvine, California, manufactures and operates low earth orbit satellites that provide remote sensing using synthetic aperture radar ("SAR"). SAR enables imaging at night and regardless of cloud cover or precipitation. ICEYE's constellation of SAR satellites provides persistent monitoring capabilities to government and commercial customers. ICEYE's first-of-its-kind system offers global access and rapid dissemination of high resolution imagery. ICEYE will have six satellites in orbit by YE 2023, and plans to launch eight additional satellites in the next two years.

Lunasonde Inc.

Lunasonde makes the underground world visible, fundamentally transforming our understanding of the planet we live on. We're pioneering subsurface imaging while providing a sustainable approach to resource exploration. Lunasonde's ability to look 15,000x deeper than current satellites and sensors is the next frontier in resource exploration. Our small satellite can locate groundwater, mineral deposits, and other geological resources up to 2 kilometers underground. Our data is collected in 3 minutes and provides a true 3D map of the earth's subsurface.

Maxar Technologies Inc.

Maxar is a leading space technology and intelligence company with $1.6 Billion in FY2022 revenue and 4,600 employees in more than 20 global locations. Maxar partners with innovative businesses and more than 50 governments to monitor global change, deliver broadband communications and advance space operations with capabilities in Space Infrastructure and Earth Intelligence. With more than 60 years of experience, Maxar designs and manufactures satellites and spacecraft components for communications, Earth observation, exploration and on-orbit servicing and assembly. Maxar's capabilities in Earth Intelligence help customers map, detect and predict change across the globe. Fueled largely by Maxar's own constellation of high-resolution imaging satellites, we provide high-resolution satellite imagery and derived data layers, machine learning and rich domain knowledge so organizations can make decisions with confidence. Upon its launch, Maxar's next-generation earth imaging constellation WorldView Legion will leverage innovative technology to yield the highest-quality commercially available satellite imagery.

Planet Labs PBC

Planet is an integrated aerospace, remote sensing, and data analytics company. It operates the largest constellation of earth observation satellites in the world, with approximately 200 satellites on orbit imaging the Earth daily in both medium and high resolution. Our data is used by governments and a wide variety of commercial companies to monitor change on Earth and use that information to make better, more informed decisions. Planet reported $191 million in

annual revenue for FY23 and has approximately 880 customers worldwide, including the U.S. Government. Planet has contracts with a variety of U.S. Government agencies, including NRO and NASA.

Spire Global Inc.

Spire is a leading global provider of space-based data, analytics, and space services, offering access to unique datasets and powerful insights about the Earth from the ultimate vantage point—space—so that organizations can make decisions with confidence, accuracy, and speed. Governments and companies around the world including the U.S. utilize Spire data and analytics to improve business operations, decrease their environmental footprint, deploy resources for growth and competitive advantage, and mitigate risk. Spire owns and operates one of the world's largest multi-purpose satellite constellations in low earth orbit. Our multi-receiver satellites obtain Automatic Identification Systems ("AIS") data from vessels, Automatic Dependent Surveillance–Broadcast ("ADS–B") data from aircraft and radio occultation ("RO") data utilizing Global Navigation Satellite Systems ("GNSS") satellites. Our fully deployed constellation consists of more than 100 satellites, and we believe it is also one of the world's largest "listening" constellations, observing the earth utilizing radio frequency sensors. We are a rapidly growing company. As of December 31, 2022, the number of ARR Solution Customers was 733, an increase from 598 as of December 31, 2021. All of the spectrum Spire relies on to provide its industry-leading sensing capabilities are shared with Federal users on a co-primary basis in the United States, namely in the UHF, S-, X-bands.

Tomorrow.io

Tomorrow.io is the world's leading Weather and Climate Security Platform, helping countries, businesses, and individuals manage their weather and climate security challenges. The platform is fully customizable to any industry impacted by the weather. Customers around the world, including Uber, Delta, Ford, National Grid, and more use Tomorrow.io to dramatically improve operational efficiency. Tomorrow.io was built from the ground up to help teams prepare for the business impact of weather by automating decision-making and enabling climate adaptation at scale. To improve global forecasting capabilities, Tomorrow.io is launching the first-of-its-kind, commercial weather satellite constellation equipped with radars and microwave sounders. As more than 5 billion people live outside of reliable radar coverage, Tomorrow.io's constellation is democratizing access to reliable global weather forecasts and enabling organizations to prepare for and mitigate the business impact of weather.